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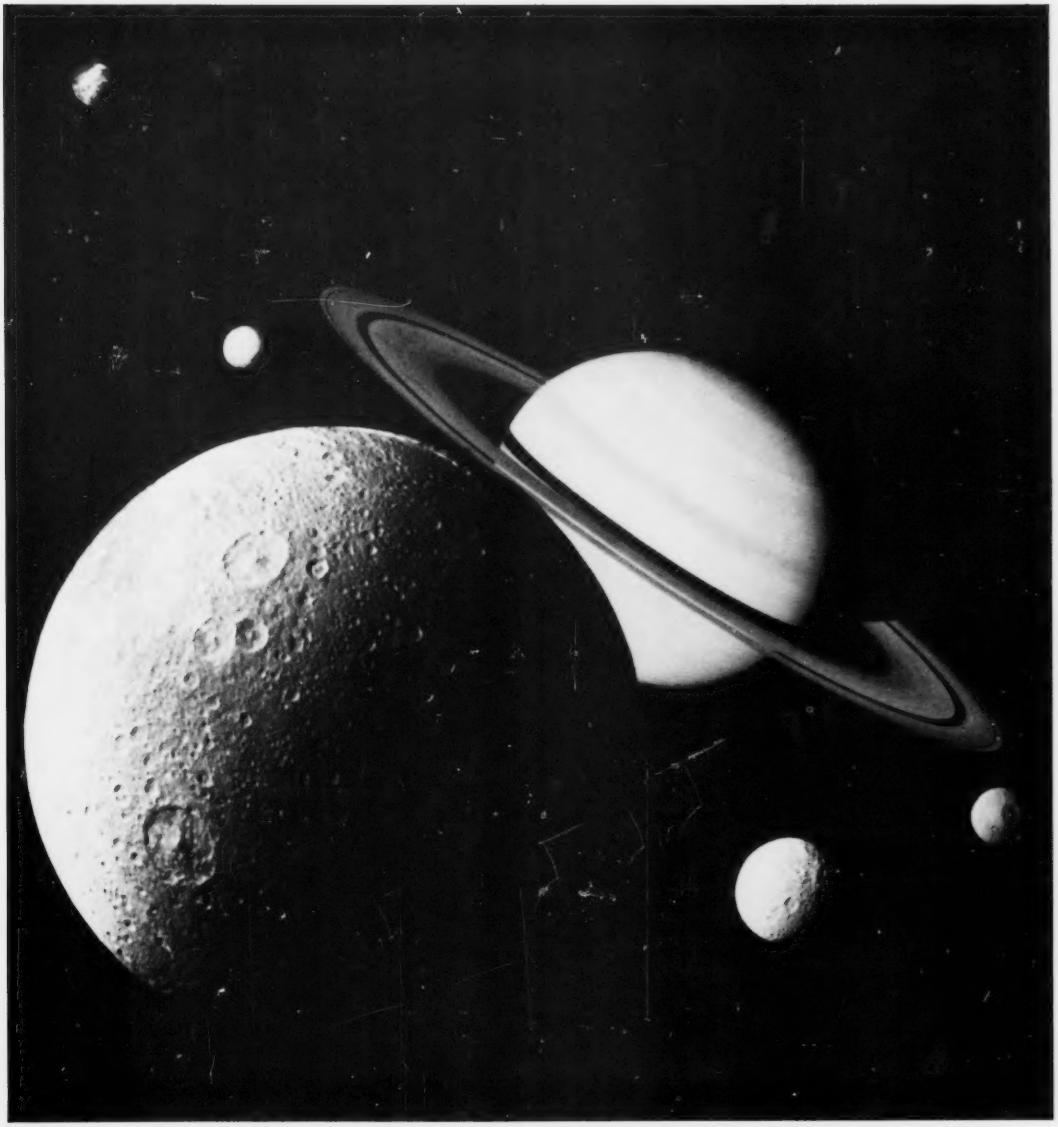

COVER

Saturnian system—This montage of images of the Saturn system was prepared from an assemblage of images taken by the Voyager 1 spacecraft during its Saturn encounter in November 1980. The Voyager Project is managed for NASA by the Jet Propulsion Laboratory, Pasadena, Calif.

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Keith McBee
Editor, Code LFD-10
NASA Headquarters, FOB 6
Washington, D.C. 20546
(Phone: (202) 755-8348)

Letter from Washington

Dear Colleagues:

This year marks the beginning of a new presidency for our nation, an administration whose theme is "new beginnings." NASA's launch of the space Shuttle *Columbia,* scheduled for March of this year, will herald a new beginning—a first in space exploration and utilization. With the liftoff of *Columbia,* NASA will send into space the world's first reusable manned spacecraft and a revolution in space travel will have begun. The *Columbia* and each successive sister ship will be key elements in a total Space Transportation System that will link Earth with space in a sophisticated communications and space research network.

1981 will also be a banner year for planetary exploration, with the Voyager 2 spacecraft's encounter with Saturn this summer. Imaging of the giant ringed planet will begin in June with the closest encounter phase in August. Voyager 2 is then scheduled to go on to an encounter with Uranus in 1986 and with Neptune three years later, in 1989.

This year will be a busy year for NASA's Expendable Launch Vehicles Program with 13 launches scheduled from January to September for a variety of scientific, weather, and communications satellites.

We will continue in our lead role for aeronautical research—to develop and improve the performance, utility, speed, safety, and efficiency of aircraft.

As we strive together to meet the challenges of this busy year, I wish to thank each of you for your continuous hard work and dedication toward achievement of our mission—to expand the frontiers of technology and knowledge for the benefit of everyone. I also wish to extend to each of you my best wishes for the new year.

Sincerely,

A. M. Lovelace

A. M. Lovelace

President to Request Venus Funds

The Administrator of NASA has been informed by the Office of Management and Budget that President Carter has concurred with the space agency's request for start-up funds for a 1986 mission to map the surface of Venus. Dr. Robert A. Frosch said OMB has assured him that the necessary funding will be requested by the President in his fiscal 1982 budget.

Launched by the Space Shuttle, the Venus Orbiting Imaging Radar (VOIR) spacecraft would circle the planet for at least seven months, taking radar pictures and making measurements of the atmosphere as well as the surface. It would be the most detailed scientific examination ever made of the surface of that planet, which is perpetually covered by clouds.

Dr. Frosch said: "I am gratified that President Carter has concurred on the request for funding for VOIR. This important scientific project will reveal the true nature and geological history of our sister planet in the same way that Mariner 9 enabled us to see Mars. Venus is completely veiled in clouds. No permanent feature has ever been identified by telescope. With VOIR, we will be able to see the surface of Venus for the first time almost in its entirety. Detailed knowledge of Venus' surface will allow us to take a large step in understanding the evolution of our own planet as well."

According to plans, NASA would launch one VOIR spacecraft from the Shuttle to Venus in 1986. A typical trajectory would begin in May or August 1986 and provide for arrival at Venus in December 1986, where the spacecraft would be inserted into a near-polar orbit at an altitude of 300 kilometers. Radar mapping and other science gathering would continue for five months or more.

The mapping activity would result in near-global coverage of the planet in moderate resolution (about 600 meters) imagery, and coverage of a small percentage of the planet's surface in higher (about 150 m) resolution pictures.

Venus has yielded her secrets with great reluctance, principally because of the obscuring clouds, crushing atmospheric pressure (100 times that of Earth) and searing temperatures (480 degrees Celsius).

Several probes, both American and Soviet, have penetrated the planet's atmosphere and transmitted important data for periods ranging from minutes to hours. Pioneer Venus has provided considerable knowledge of Venus' atmospheric properties. But

none has provided a satisfactory picture of the Venusian surface.

The VOIR imagery is expected to disclose the presence of continents, ocean basins, mountain belts, rift valleys, fault belts or volcanoes. The nature and time sequence of plate tectonic activity (continental drift) may also be revealed, as well as any relationship between this and volcanic episodes in the history of the planet.

If impact craters are present, as suggested by Earth-based radar observations, their size and frequency can be determined. Other science investigations will be conducted which relate to the planet's fundamental geophysical and atmospheric problems.

The VOIR orbiter—weighing approximately 5,000 kilograms at launch—will consist of a structure with a synthetic aperture radar and other science instruments. Estimated cost of the project is $500 million to $600 million.

The project will be managed by the Jet Propulsion Laboratory, Pasadena, Calif., a government-owned facility operated for NASA by the California Institute of Technology.

HiMAT Makes Sixth Flight

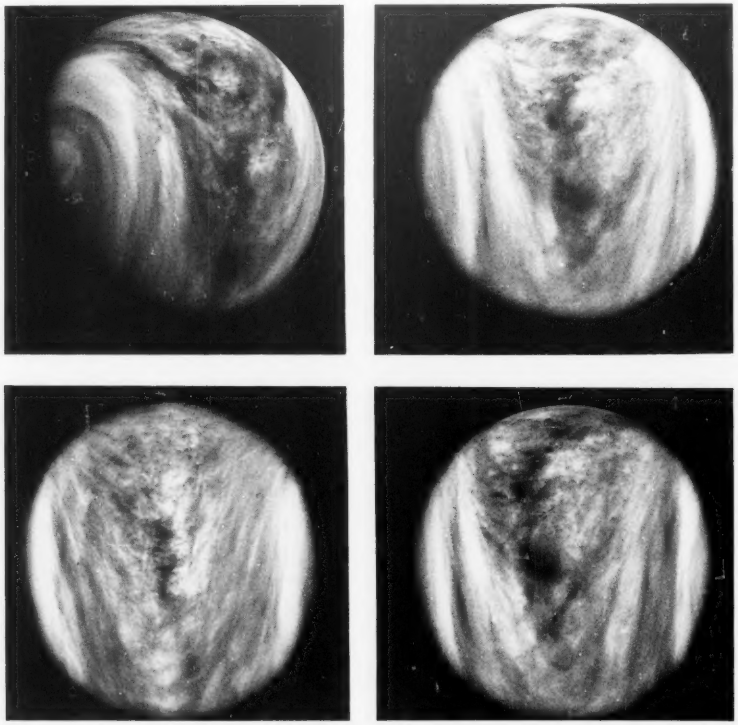
HiMAT (Highly Maneuverable Aircraft Technology), the remotely piloted research vehicle with twice the maneuverability of present-day fighters, has completed its sixth free flight at NASA Dryden. During the 32-minute flight, the 44 percent scale version of a potential future fighter made a 7-G, seven times the force of gravity, wind-up turn.

Following launch from the B-52 mother ship at 45,000 feet, the HiMAT descended to 25,000 feet where it demonstrated for the first time afterburner operation to a Mach number of .90, approximately 600 m.p.h.

The aircraft was then put into a 6.5-G equivalent wind-up turn in preparation for the wind-up turn which took place later in the flight.

Stability and control data was gathered at .90 Mach number and the HiMAT was then flown into a wind-up turn in excess of 7-G for approximately 11 seconds.

The HIMAT, flown from a ground cockpit, landed on Rogers Dry Lakebed following its flight.



Venus and its perpetual cloud cover.

Satellite Service Study for NASA

How do you go about replacing parts or tuning up ailing systems on a satellite that is orbiting hundreds of miles above earth? A study contract awarded to Lockheed Missiles & Space Company by NASA will help provide some answers.

Under the auspices of the Johnson Space Center, Lockheed will assess servicing requirements of current and planned on-orbit spacecraft and will define ways the Space Shuttle can be used to perform such services as replacing failed equipment, resupplying expendable fuels and upgrading experimental packages.

The Shuttle-mounted remote manipulator system will provide some initial satellite maintenance, repair, placement and retrieval capabilities. However, space systems such as multi-mission spacecraft, low-earth orbit science and applications platforms and the Space Telescope will require more diverse services and equipment.

"We feel confident we can devise efficient and versatile satellite service capabilities for the ever-growing space transportation system," said Dan Ruskin, director of Advanced Systems in the Space Systems Division at Lockheed. He noted that his company's experience in developing servicing capabilities for the Space Telescope and other NASA systems will provide valuable insight into defining a more diverse satellite service system.

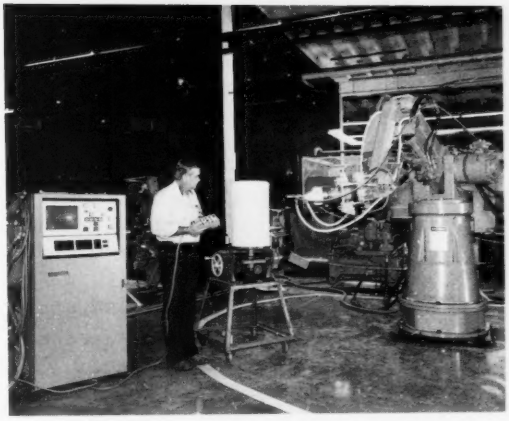
Before designing new equipment, Lockheed will screen NASA hardware to determine which existing (or planned) equipment can be used "as is" to fulfill certain service functions. The company will then define modifications required to bring other equipment up to par for evolving service needs.

Robots Work On Shuttle Hardware

The robots are coming, the robots are coming! In fact, a couple of them are already at Marshall Space Flight Center, and another one is on the way.

Not to fear, though. These are industrial robots, bearing little resemblance to the androids of "Star Wars" and they're the vanguard of the growing worldwide army of "smart" machines which can do some jobs better, cheaper, faster and safer.

Process engineering employees at Marshall's Materials and Processes Laboratory are working to advance the current state-of-the-art in the utilization of robotics to improve manufacturing techniques associated with Space Shuttle hardware production. They are integrating robotics into total computer-controlled systems designed to improve process engineering technology to meet high launch rate fabrication and between-flights refurbishment requirements of recovered, reuseable Shuttle hardware.



An industrial robot at the Marshall Center is programmed by James P. McLemore, for automated spray application of an experimental thermal protection coating onto a thermal test drum, center, which represents the Space Shuttle External Tank.

One of Marshall's two robots is part of an automated process developed for spray application of the thermal protection system, or foam insulation, to Shuttle solid rocket booster structures, such as forward and aft skirts, and nose cones. The second Marshall robot, now temporarily in use for advanced welding applications, will be integrated with specialized equipment now being installed at the Center to advance materials and processing technology unique to the thermal protection of the Shuttle's external tank.

A third highly sophisticated computer-controlled unit now being procured by Marshall for installation in December is a robot-manipulated high-pressure water blast system designed to automate the stripping of insulation materials from recovered booster hardware.

After complete development and performance qualification of these automated systems at Marshall, the Shuttle Projects Office plans to implement appropriate technology into the booster and external tank processing cycles at the Center's Michoud Assembly Facility at New Orleans and the Kennedy Space Center in Florida.

Michoud has recently acquired three industrial robots, expected to be placed in service by the end of this year for a variety of purposes including welding and riveting as well as spraying on external tank insulation. Kennedy also has three robots, currently available for application of booster hardware insulation.

In the case of the Marshall Center's insulation removal equipment and controls, the total system will ultimately be shipped to Kennedy for refurbishment of operational booster hardware.

The Marshall system will consist basically of a high-pressure (up to 138 million newtons per square meter) pump forcing water at supersonic speed through a nozzle manipulated by a robot to blast away insulation from booster structures rotated on an airbearing turntable.

When fully qualified, this automated system will result in a faster, safer, more efficient means to remove spent ablator materials and greatly reduce refurbishment time for Shuttle hardware.

The Marshall Center's new computerized robotic system for spraying foam insulation onto external tanks is expected to be ready this month.

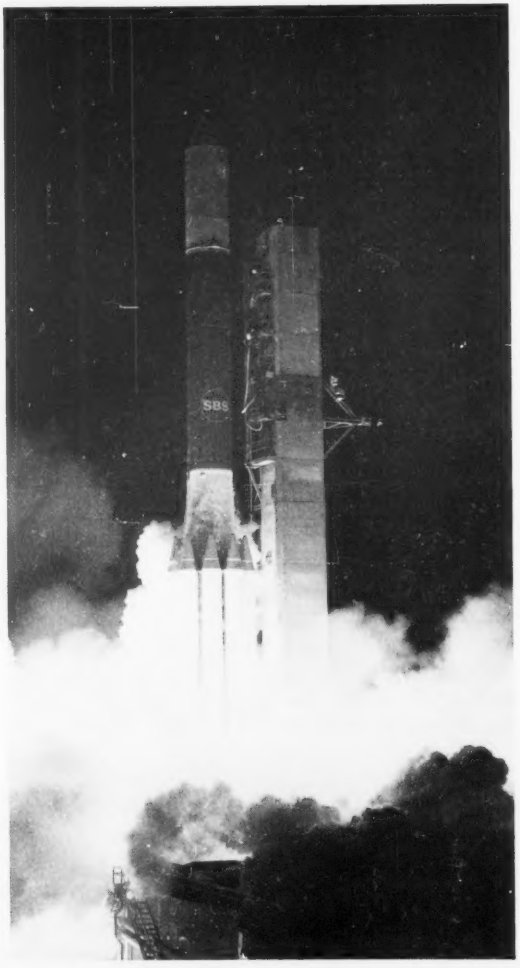
A prototype production facility is already in operation at Marshall to extend computer-controlled robotics technology to the spray application of insulation for flight booster hardware. The automated processing equipment includes—in addition to a programmable robot—a continuous-flow insulation material circulation system, an automatic spray gun, an electronically controlled turntable and a computer which integrates and controls the entire system.

Largest Small Business Contract

NASA's Kennedy Space Center has awarded its largest contract ever to a small business to the W&J Construction Corp., Cocoa, Fla. The $6,689,666 agreement is for work on Pad B of Launch Complex 39 which will be used to launch the Space Shuttle in 1982, when the Shuttle becomes operational.

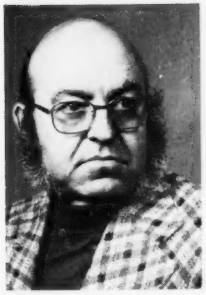
Under the fixed-price contract, W&J Construction, which has had previous Kennedy center contracts, will install the long-run piping and cable to pump and monitor fuels, coolant, gaseous helium and nitrogen, compressed air and hydraulic fluids from their storage areas on the pad to the fixed service structure and the rotating service structure.

Connections to the Space Shuttle are made from the two service towers. Work is expected to be completed in 20 months. Pad B of Complex 39 is basically a duplicate of Pad A, the pad to be used to launch the first Shuttle flight next year. Pad B will be used when the Shuttle begins regular operations. Complex 39 was the launch site for the Apollo moon landing missions and is being modified for Space Shuttle flights.



SBS-1 liftoff—SBS-1, the first of three advanced commercial communications satellites established by Satellite Business Systems. The successful launch occurred Nov. 15 at 5:49 EST from Cape Canaveral Air Force Station, Fla. This satellite is designed to meet the communications needs of American business firm; its antenna range covers the continental United States.

Dr. Naugle Back at Headquarters



Dr. John E. Naugle, former Chief Scientist of NASA, has returned to the space agency on a temporary basis as Acting Chief Scientist. Naugle will be the principal scientific advisor to the NASA Administrator and will continue as a member of the NASA Advisory Council with the responsibility for planning long-range solar system exploration and for looking at other possible long-range goals for NASA. Naugle retired from NASA in June 1979. He joined the space agency at the Goddard Space Flight Center in 1959 as head of the Nuclear Emulsion Section.

In 1961 he became Chief of Physics, Physics and Astronomy Programs in the Office of Space Science at NASA Headquarters and from June 1962 until May 1966 he was director of Physics and Astronomy Programs in the Office of Space Science and Applications.

He was appointed Associate Administrator for Space Science and Applications in 1967 and became Deputy Associate Administrator of NASA in 1974. Naugle assumed duties of Acting Associate Administrator in April 1975 and Associate Administrator of the agency in November 1975. He was named Chief Scientist in November 1977.

Guastaferro Named Deputy at Ames

Angelo Guastaferro, Director of NASA's Planetary Division in the Office of Space Science, has been named Deputy Director of the agency's Ames Research Center, Mountain View, Calif.

Guastaferro is expected to assume his new duties at Ames in approximately five months. His predecessor at Ames was Dr. A. Thomas Young, who is now Director of NASA's Goddard Space Flight Center. John Boyd, Ames Associate Deputy Director, will continue to serve as acting deputy until Guastaferro's arrival.

Guastaferro began his NASA career in 1963 at Langey Research Center, Hampton, Va. He served at Langley in a variety of aerospace research and development projects including the Viking project and the Rotor Systems Research Aircraft project.

Preceding his NASA positions, Guastaferro served as an officer and then as a civilian with the Air Force at Eglin Air Force Base in Florida as an aeronautical project engineer.

Guastaferro received his bachelor's degree in mechanical engineering from New Jersey Institute of Technology in 1954. He also received an M.B.A. in research and development management from Florida State University in 1963.

He received the NASA Special Achievement Award in 1974, 1977 and 1978, a Group Achievement Award in 1977, and a NASA Outstanding Leadership Medal in 1977 while at Langley. At Headquarters he received the NASA Exceptional Performance Award this year.

He and his wife, the former Eleanor Lago, make their home in Alexandria, Va., and they have three sons.

Exchange Program for NASA Execs

A unique development opportunity for NASA executives is available through the President's Executive Exchange Program (PEEP). This program offers highly select employees from the private and Federal sectors the opportunity to gain experience by crossing sector lines for a year during the important middle period of their careers.

The sponsoring organization benefits also from both the growth of the exchange executive and the specific skill and knowledges that are obtained from the assignment.

In addition to the actual job experience, executives are also involved in an extensive education program to further inform them of current and developing policy questions which affect business and its relationship with Government. A week-long orientation in Washington, D.C. begins the program year, and a week-long program for the Federal executives is planned at the Wharton School of Finance and Commerce in December. In order to prepare executives to evaluate international conditions which influence current and future decisions of business and Government, a two-week International Study is planned abroad in mid-year.

There are *two important changes* in the program. One, GS-15 nominees that are successfully placed in an industry assignment will be considered in the

NASA SES Candidate Development Program. This means that upon successful completion of the assignment and any additional requirements in the individual development plan, the exchange executive would be pre-certified by OPM as qualified for the SES by virtue of participating in an approved SES Candidate Development Program.

The second important change provides for much greater control of and participation in the selection of the firm and assignment location by the nominee and NASA. That is, upon selection as a PEEP executive by the Commission, the executive is required to research six business firms of his/her and the sponsoring installation's choice. This research involves statements indicating: the reasons for selecting the firm, what the executive can contribute to the firm, what assignment is most desirable, and how NASA will benefit. These statements are forwarded to the firms. Negotiations with interested firms occur during April to July, with assignments starting in mid-September.

Nominees should be GS-13 through SES, in the important middle period of their careers, and have a proven record of management ability and identified potential for advancement to higher level management responsibilities. The agency pays all expenses such as relocation and program education costs. The hosting firm pays salary. There is no cost to the sponsoring NASA installation.

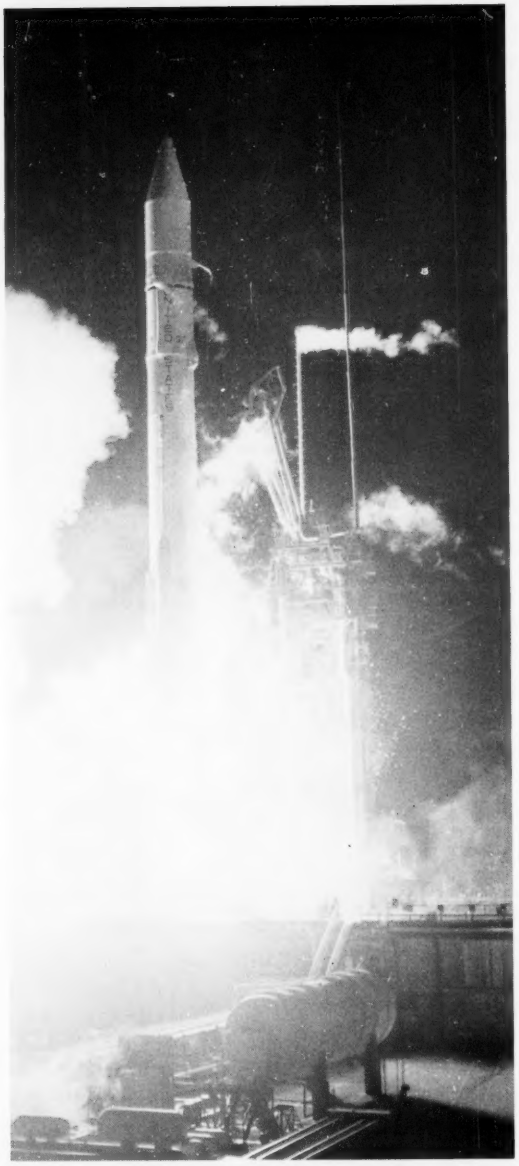
The selection process allows for self initiated request for nomination. Nominations are due in the Office of Development by February 15. Interested persons should contact your training office for local suspense dates, selection procedures, and additional program details.

NASA/TVA to Work on Energy

The National Aeronautics and Space Administration and the Tennessee Valley Authority have signed a memorandum of understanding on NASA's support to TVA in energy research, development and demonstration.

NASA is already active in supporting a Department of Energy national program of energy research and development. Agency centers have facilities adaptable to energy research and technology development.

The specific nature and details of future energy projects to be undertaken by NASA for TVA will be defined and provided for in individual agreements



Another successful launch—FLTSATCOM-4, the fourth in a series of Defense communications satellites, was successfully launched October 30 by an Atlas Centaur 57 from Complex 36A at Cape Canaveral Air Force Station, Fla. Liftoff occurred at 10:54 EST. The two-ton satellite circles Earth from a geosynchronous orbit at 172 degrees longitude above the equator where it will provide two-way communications in the 240 to 400 megahertz frequency band. The spacecraft has a design life of five years.

made under the general terms of the basic memorandum, and for which NASA will be reimbursed by TVA.

TVA and NASA are currently negotiating a reimbursable agreement for support by the Marshall Space Flight Center, Huntsville, Ala., to the TVA coal gasification project. The memorandum was signed by W. F. Willis, General Manager of TVA, and Dr. Alan Lovelace, Deputy Administrator of NASA.

Lewis Hosts Communications Seminar

An in-depth review of NASA's 30/20 gigahertz (GHz) communications program was conducted November 18–19 by Lewis Research Center. The review was designed to bring communications carriers, industrial suppliers and government agencies up-to-date on the program.

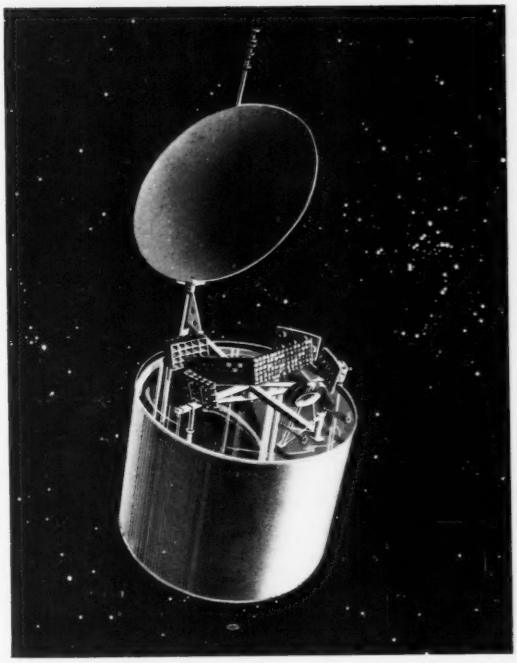
Some 88 companies were represented and more than 300 representatives of industry, universities and government agencies participated.

Potential applications of 30/20 GHz satellite communications include: wideband, low- and medium-speed data services; electronic funds transfer; electronic mail; secure and private line voice; public and business telephone service; radio program transmission; mobile radio telephone; CATV distribution; teleconferencing; interactive home video; public broadcasting systems; commercial video distribution; and network trunking.

Recently concluded studies show that by the early 1990s growing demand for long-distance telecommunication services will have saturated the nation's existing domestic satellite capacity in the lower frequency bands of 4-6 GHz and 11-14 GHz. To accommodate this expected rapid growth in demand, more versatile satellites that have a higher capacity and operate in the higher frequency 30/20 GHz band will be required.

The NASA Lewis Research Center has lead responsibility for management of the NASA communications program in general and the 30/20 program in particular.

First day overview briefings were given by Lewis personnel and the second day speciality sessions by industry and Lewis. During the specialty sessions one example of the technology discussed was the development of multiple-beam antennas. These antennas will open the door to frequency reuse in the 30/20 GHz band and also in the lower frequencies.



30/20 gigahertz communications satetllite concept designed by Hughes Aircraft Company.

Artist's concept of master control station at Lewis with ground terminal.

The use of many narrow beams isolated in frequency from one another permit the same frequency to be used for several beams, each "illuminating" a different spot on Earth.

Another important technology being studied is a switching system that will be onboard the satellite to interconnect the spot beams and route signals to their appropriate destinations. Technology development for the onboard switching system also includes work on a processor that will enable processing and signal routing at baseband frequencies. Processing at baseband will permit error detection and correction and will improve overall system performance.

Other work studied includes development of a high-power satellite transmitter for operation at 30/20 GHz. In this area, one device under study is a traveling wave tube capable of high power output and a 10-year life. Also examined were efforts to develop low-noise receivers for use on the satellite and the technology needed for developing low-cost ground terminals.

This review was one of a series planned to provide a forum for the interchange of information and ideas on advanced satellite communications technology between government and the commercial sector.

The Shareholders in Space—The Space Shuttle Columbia looks down upon a part of the American public at KSC's Orbiter Processing Facility. This was an open house and Kennedy center workers and their families were invited. In late August, the famous spaceport recorded its 15 millionth visitor and attendance has exceeded 1.2 million people for the past two years. Even more dramatic will be the upswing in tourists as the time to launch the Shuttle approaches.

Shuttle Payload Prepared—Technicians at Goddard Space Flight Center are completing integration of experiments on OSS-1, the first space science payload. The seven experiments cover the disciplines of space plasma, physics, astronomy and life sciences. OSS-1 is tentatively planned for NASA's fourth Space Shuttle orbital test flight in 1982.

Fluid Battery Development Plan

New component developments in the REDOX (reduction oxidation) fluid battery, a unique energy storage system developed by Lewis Research Center have made the system technologically feasible for prototype development.

"Advancements in membrane and electrode technologies within the past six months have brought REDOX to the stage where its development and scale-up for eventual use in a broad range of storage applications is now appropriate," reports Dr. Louis Rosenblum, Chief of the Solar and Electrochemistry Division at Lewis.

"With the experience we've received in the operation of our experimental one-kilowatt unit, the technology is ready to be transferred to American industry for large scale prototype development," said Rosenblum.

Beginning in January 1981, industry will be asked to submit proposals for a multikilowatt prototype. These proposals will reflect industry involvement in a cost-shared development effort leading to a commercially viable system. The first multikilowatt prototype is scheduled for field testing in mid-1983. The multi-megawatt unit is scheduled to begin system design, fabrication and testing in early 1984.

To stimulate both industrial commitment and market acceptance of REDOX technology, the REDOX multiyear development program will focus on government and industry cost-sharing the risk associated with any new technology. Current funding for REDOX is provided by the Department of Energy.

REDOX promises major cost reductions in the storage of electrical energy as well as long-term reliability and minimal environmental impact. For electric power companies, REDOX could be used as an efficient, cost-effective means of "load leveling"—the storing of thousands of kilowatt-hours of energy during low demand periods for use later during periods of maximum power consumption.

On a smaller, more immediate scale, REDOX systems in the kilowatt range should help to stimulate the growth of solar cell and wind energy systems where the cost of electrical storage is an important consideration. Other applications could include a REDOX system in combination with a hydroelectric plant or use by private industries, municipalities and rural electric cooperatives which could buy energy from electric utilities during less expensive off-peak hours and store it for later use.

In contrast to conventional lead-acid batteries, REDOX converts chemical energy into electrical energy when two reactant fluids—chromium chloride and iron chloride—are pumped through a "stack" of flow cells. Each cell contains a highly selective ion exchange membrane which keeps the fluids separate, yet permits the transfer of electrical charge as each fluid reacts at a separate inert electrode surface.

As the fluids circulate through the stack and electrical energy is withdrawn from the system, the net electrochemical energy in each fluid is depleted until the system is fully discharged. To recharge, the fluids are simply pumped through the stack again, but with electrical energy supplied from an outside source.

Recent developments advancing the technological feasibility of REDOX have focused primarily on two elements of the flow cells—the membrane separating the chromium and iron solutions, and the chromium-side electrode. Improvements to these components have resulted in systems which meet all current requirements for solar photovoltaic and wind applications. Additional near-term improvements expected in membrane structure will meet the more rigid

requirements of electric utility use.

Overall management of the REDOX program is provided by the Office of Advanced Conservation Technologies under the Department of Energy Assistant Secretary for Conservation and Solar Energy.

Department of Energy program management supervision for REDOX and other electrical storage systems designed for solar applications is provided by Sandia National Laboratories in Albuquerque. Direction for utility applications is provided by the Department of Energy's Chicago Regional Operations Office.

Wind Tunnel Modification

Steelwork for the addition of a new, larger test section to the Ames 12 by 24-meter wind tunnel began in early December.

The additional structure, which is 182 meters long and culminates in a 110-meter-wide and 40-meter-high bell-shaped air intake, will extend to the northwest from the west side of the present wind tunnel. The structure will house a new 37-meter-wide, 24-meter-high test section making it the largest wind tunnel test facility in the world.

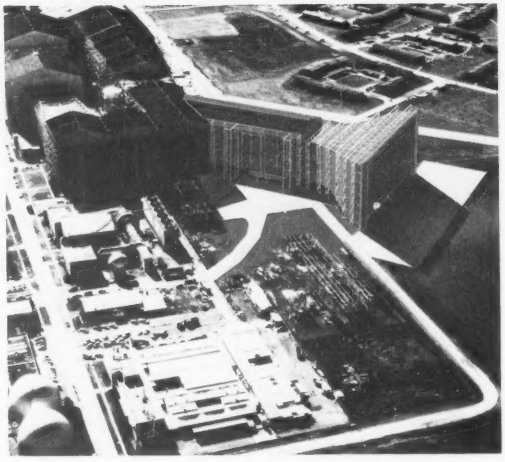
Assembly and erection of the structure will take about a year. The total project involves 45 separate contracts and several hundred people. At any one time there are about 200 people working at the construction site.

The completed facility with its two test sections (the original 12 by 24-meter test section and the new 25 by 37-meter test section) will essentially be two complete wind tunnels which share a common drive system. A major part of the $85 million project is to replace the present 36,000 horsepower drive system with one of 135,000 horsepower. This will increase the top speed available in the present test section from 370 kilometers per hour to 555 kilometers per hour, and provide test speeds in the new larger test section of up to 185 kilometers per hour.

The new drive system will utilize low speed fans and extensive acoustic treatment, both part of a major effort to reduce the amount of noise generated in the system to an absolute minimum.

An important use of the new facility will be for low-speed testing of aircraft with engines operating. Such studies are important in reducing aircraft noise during landings and takeoffs, in developing high-lift systems to reduce takeoff and landing distances, and in improving flight performance of airplanes in congested terminal areas.

The new facility with its increased speed and size capabilities is expected to make important contributions to research programs to develop the next generation of military and civil aircraft which will fly much more quietly and efficiently than today's models.



This aerial view of the Ames 40- by 80-foot wind tunnel (upper left) has been retouched by a NASA artist to show the new larger test section which will greatly increase its research capabilities. The new structure (upper right) will contain a 80- by 120-foot test section, extends from the west wall of the wind tunnel and terminates in a 362 foot by 132 foot bell-shaped air intake. The construction phase of the $85 million project is scheduled to be completed in mid-1982.

Ways to Detect Eye Problems

The Marshall Space Flight Center is lending its space-age expertise to an Alabama project which may save the eyesight of children. Marshall is providing overall program management, coordination, liaison and computer technology for the development of an "ocular screening system," a much-needed accurate method of detecting eye defects and diseases quickly, according to Aubrey D. Smith, director of MSFC's Technology Utilization Office.

The system will have many applications related to eyesight problems but will be an especially important means of screening infants and other noncommunicative persons for amblyopia, detecting eye diseases in

their formative stages and evaluating treatments, Smith said.

Amblyopia is poor vision in an eye despite efforts to correct the problem with glasses. If untreated, amblyopia may result in vision degradation up to blindness of the eye. About four percent of the general public exhibit symptoms of amblyopia. Children should be screened frequently from infancy through childhood, but screening programs have not been instituted in the United States due to the lack of a simple, reliable and fast method that is relatively inexpensive.

The retinal reflex screening test that is the basis for the new method has all the attributes of an ideal procedure—fast, does not require that the subject be in a special examination room nor that the subject talk or cooperate more than looking at the lens of the instrument.

The system consists of a 35 mm camera with a telephoto lens and strobe light, plus an optical correlator which is being developed for comparing retinal reflexes of the subject's eyes.

The way it works: The strobe, mounted just below the level of the camera lens, sends light into the subject's eyes from a distance of 6 meters. This light is reflected from the retina at the rear of the eye back out to the camera lens and onto color film.

Two healthy eyes will have pupils which appear red and have identical images. When pupils appear different, this is an indication of amblyopia, tumors, cataracts, crossed eyes or other defects.

Lewis to Spur Electric Cars

The ultimate proving ground for automobile components has always been the test track and highway. Now, under a program sponsored by the Department of Energy, NASA Lewis Research Center is ready to proof-test propulsion systems and components of electric and hybrid vehicles with a road load simulator unique in the country. The new facility will enable Lewis engineers to test electric and hybrid vehicle propulsion systems and components under conditions closely resembling those of the test track and road.

"While not a complete replacement for road tests, the road load simulator will be an important tool for evaluating various competing concepts," said Harvey J. Schwartz, head of the Lewis Electric and Hybrid Vehicle Project Office.

"It should accelerate, and lower the cost of developing electric and hybrid vehicles. This, in turn, should help make practical electric and hybrid vehicles available sooner and help reduce the nation's dependence on foreign oil," he adds.

The Lewis "test track" is inside a 6-by-12-meter room. The "driver" is a computer-like programmable controller. Propulsion components and systems under test experience the same types and ranges of loadings as they would on the highway.

Such road test variables as vehicle weight, tire types and sizes, aerodynamic drag and road gradients are readily simulated. The programmable controller can vary drive torques, speeds, loadings and running times to simulate either long freeway trips or city driving with its multiple stops and starts.

The major cost-saving aspect of the Lewis road load simulator is its ability to test propulsion systems quickly without the expense of installing them in vehicles.

"We'll be able to evaluate the road performance of a system concept early without investing the time and money to develop it completely so that it can be installed in a road vehicle," said Schwartz. "Such an evaluation will permit us to make an early informed decision on the merits of a concept. Our ultimate goal is to quickly arrive at affordable systems that can perform defined missions at reasonable cost."

Lewis believes another benefit of the road load simulator is its ability to measure performance accurately under controlled conditions. Precise collection of data on a test track is difficult because of track variables such as wind and weather, track surface variations and driver variables. In addition, it is difficult to adequately instrument a road test vehicle to obtain data. All these problems are eliminated in the road load simulator.

The road load simulator consists of a programmable controller that controls the operation of both the simulator and the system under test, inertia wheels to duplicate the mass of the vehicle, two hydroviscous drives that serve as an energy absorber and clutch, a 150-horsepower motor that provides motoring torque, and instrumentation and data processing equipment for measuring and recording tests results.

Motoring torque is required in order to simulate downhill operation, especially in an electric vehicle because part of the energy available while coasting or braking can be recovered in a process called

regenerative braking which increases the range of the vehicle.

As another feature, the new test facility can provide controlled, constant power to simulate a vehicle's propulsion battery. Characteristically, battery output varies with age, state-of-charge and temperature, and this is not desirable for some tests. The road load simulator includes a motor generator set which, when coupled with a large capacitor bank to filter the output, can replace the vehicle battery. This enables testing of propulsion systems and components without the influence of changing battery power characteristics.

The road load simulator was installed at Lewis by the Laboratory Equipment Corporation of Mooresville, Indiana. The first system scheduled for test is the ETV-1 electric propulsion system built by the Department of Energy under a contract with General Electric's Corporate Research and Development Center.

Astronomy Yields Neutrino Clues

A NASA scientist has found possible new evidence suggesting that the subatomic particles known as neutrinos have mass, and that our galaxy may be surrounded by vast numbers which were produced during the first few moments of the birth of the universe. Until recently, neutrinos were thought to have no mass, like photons.

Dr. Floyd W. Stecker, of the Laboratory for High Energy Astrophysics at the Goddard Space Flight Center, Greenbelt, Md., says there may be new astronomical evidence based on a recent suggestion by CERN (Center European De Recherche Nucleaire) physicist A. de Rujula and Nobel Laureate Sheldon Glashow of Harvard University that if neutrinos have mass, evidence for their decay might be found in ultraviolet astronomical observations.

Dr. Stecker, writing in the Oct. 27 issue of Physical Review Letters, concludes that tentative evidence of a spectral line, which may be from decaying neutrinos, exists near the ultraviolet wavelength of 0.00017 mm in various rocket observations.

Ultraviolet astronomical observations can only be made above the Earth's atmosphere, with rockets and satellites. Dr. Stecker used rocket observations by Dr. Richard Henry of The Johns Hopkins University and his collaborators as well as observations of a French group working with data from the French D2-B spacecraft. Future ultraviolet astronomy studies, providing more refined observations, are needed in order to further test the neutrino-decay hypothesis, according to Stecker.

The hypothesis, if it is correct, holds important implications for theories dealing with the nature of all matter and the ultimate fate of the universe.

The strength of emission lines from ultraviolet spectroscopy gives important evidence on the rate of decay, which in turn is inversely proportional to lifetime. Stecker believes that if his interpretation of the ultraviolet data is correct, these neutrinos live so long that only one neutrino in 10 million would have decayed since the universe began (under the Big Bang theory of cosmic evolution).

According to the Big Bang theory, all of the matter of the present universe was originally packed together in a primeval fireball—an extremely hot, dense ball that exploded about 15 billion years ago. The gigantic explosion threw hydrogen, helium, electrons and radiation out into space. The matter that was spewed into space expanded and cooled, and several million years later, it condensed into galaxies. The universe has continued to expand, and the galaxies have continued moving away from each other ever since.

One part of the Big Bang theory states that there are roughly a billion neutrinos for every proton in the universe. (Protons are the nuclei of hydrogen atoms, which account for 90 percent of the atoms in the universe.) Our galaxy may be surrounded by a spherical sea or "halo" of neutrinos which were created in the first moments of the Big Bang, some of which are decaying all the time.

If Stecker's conjecture is correct, the "heavy" neutrinos which produce this spectral line at the observed wavelength would weigh so little that it would take a billion of them to equal the weight of one nitrogen atom. However, there are so many of them that they would make up the bulk of the mass of the universe and account for the mysterious "missing mass" in large clusters of galaxies.

The determination of the fundamental properties of neutrinos, such as their mass and lifetime, provides important clues to understanding the nature of all matter. In addition, the exact determination of the masses of all types of neutrinos (of which three are presently known) will enable astrophysicists, using the general theory of relativity, to deduce whether the universe will keep on expanding forever or will eventually collapse, producing a new Big Bang.

Marshall Balloon Experiments Return

By a remarkable coincidence, two 30-story-tall balloons launched from Palestine, Texas, carrying Marshall Space Flight Center experiment packages, both floated almost directly over the center last month before coming to Earth and being recovered in Virginia and West Virginia.

"It's really amazing—in fact, almost unbelievable —that both our payloads came right over us after drifting some 700 miles," said Dr. Gerald Fishman, of Marshall's Space Sciences Laboratory, principal investigator for one of the experiments. Marshall has been involved in the research balloon program for seven years, he added, but no balloon—much less two —had ever passed over the center before.

"These two flights were also the most successful thus far," Dr. Fishman said. "Over 28 hours of gamma-ray data and over 38 hours of cosmic-ray data were recorded."

Both balloons—each 90 meters in diameter—were traveling 32 to 56 kilometers per hour, approximately 37 kilometers up. The first balloon, launched Oct. 6 and carrying a gamma-ray detector experiment, passed over Huntsville about 1:30 p.m. Oct. 7, and was easily visible to the naked eye. Marshall scientists followed it by telescope, and took pictures through their instruments.

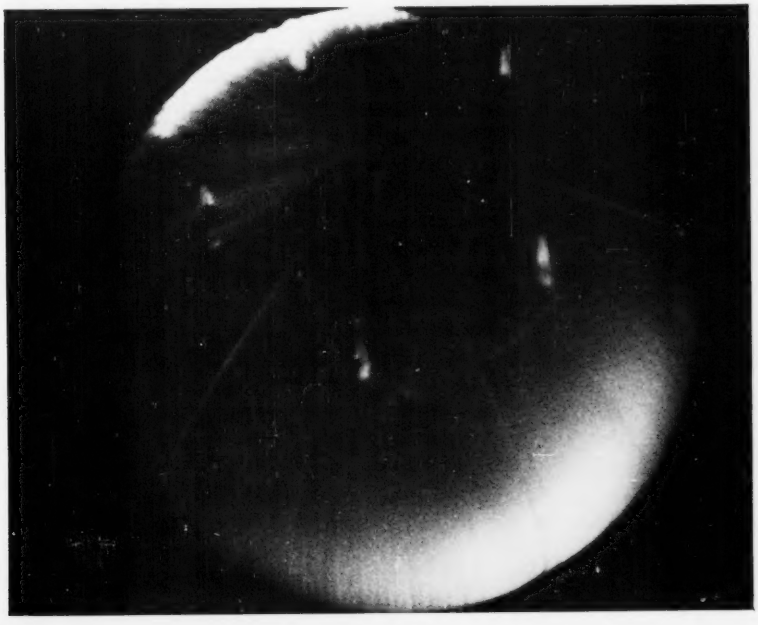
The second balloon, launched Oct. 7 and carrying a cosmic-ray detector experiment, came over Huntsville about 3 a.m. Oct. 8. Both balloons, traveling in a north-easterly direction, were tracked by Marshall personnel from a telemetry station set up on Madkin Mountain on Redstone Arsenal to receive data from the experiments.

The balloons were cut down at the end of their missions by explosive charges triggered by radio commands from a chase plane, and their payloads were parachuted to the ground for recovery. The gamma-ray astronomy flight ended the morning of Oct. 8 and the cosmic-ray flight that afternoon.

A recovery crew from the National Scientific Balloon Facility in Palestine, which had launched the balloons, recovered the gamma-ray package in excellent condition about 16 kilometers north of Roanoke, Va.

After picking up the first payload, the crew headed for the cosmic-ray package, which had landed in a heavily wooded area about 24 kilometers southeast of Elkins, W. Va. The crew reached the payload by foot and found it to be in good condition. A helicopter was later used to retrieve the package.

Both packages were returned to the Marshall Center for analysis and possible future use.



This photograph of a 90-meter-diameter balloon launched from from Palestine, Tex., and carrying a gamma-ray detector experiment developed at Marshall, was taken in October when the balloon was almost directly over the center—through a seven-inch solar white-light telescope at the Space Sciences Lab's Solar Observatory. The five small white spots on the balloon are ducts which vent excess helium.

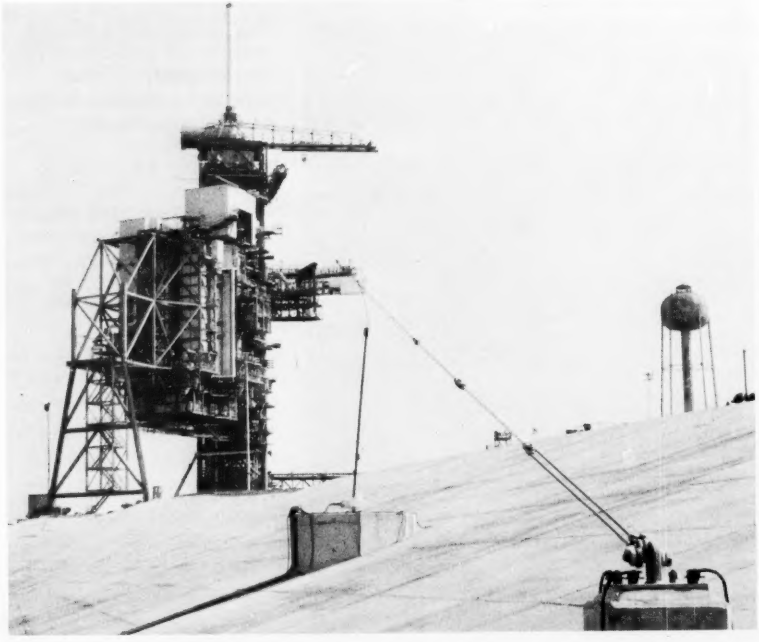
Contractor News

Ball Aerospace Systems, Division of Ball Corp., Boulder, Colo., has been selected for negotiation of a contract to provide the Earth Radiation Budget Satellite as well as its mission operations support. The contractor's proposed estimated cost of this cost-plus-award fee contract is approximately $21 million. The satellite is to be integrated, tested and delivered ready for launch on the Shuttle by April 1984. The satellite, with its Earth Radiation Budget Experiment instruments, will become part of a three-spacecraft system—with NOAA-F and G—to use scanning and non-scanning radiometers to measure the amount of solar radiation received and given up by different regions of the Earth.

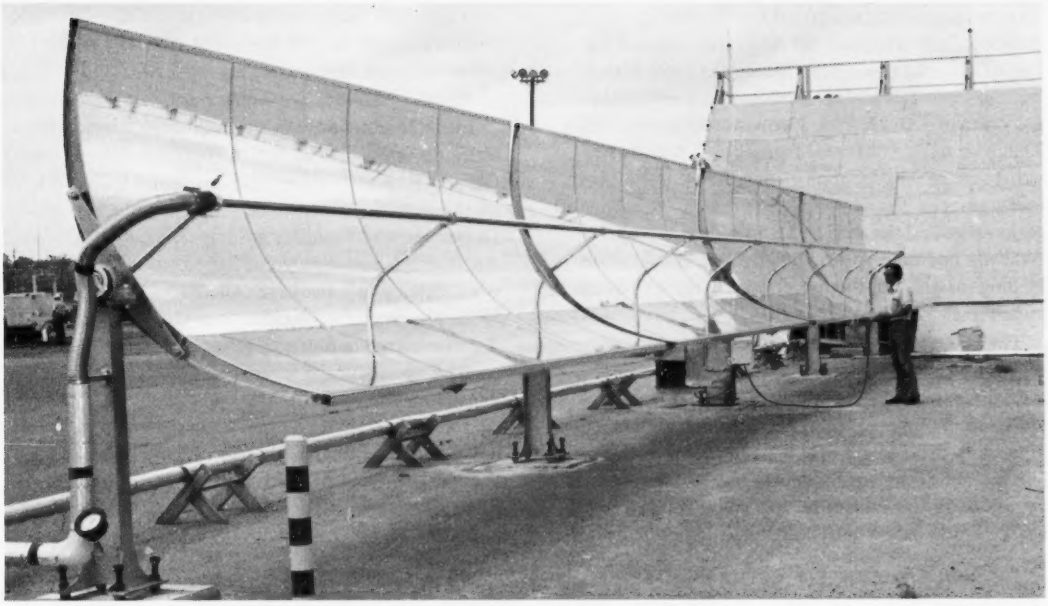
Martin Marietta Corp., Denver, has been selected for negotiation leading to award of a NASA contract for the design and development of a modular, programmable, real-time processing system for future NASA space missions. The contract, valued at approximately $2 million, calls for the use of new signal processing technologies now emerging to allow many processing functions, previously performed on the ground, to be performed onboard the spacecraft. Under the contract, Martin Marietta will provide test support and demonstration equipment, to include test data and control of the software and display hardware. The functional elements to be developed include radiometric corrections, geometric correction and data packetization.

Energy Research Corp., Danbury, Conn., has been awarded a $2,917,800 contract by the Lewis Research Center for fuel cell technology for on-site total energy systems and electric utility applications. The two-year cost-sharing award was made under the Department of Energy's Phosphoric-Acid Fuel Cell Systems Program, managed by Lewis. Under this contract Energy Research Corp. will develop a fuel cell stack assembly that can provide the 120 kilowatts of capacity necessary to meet all heating, cooling and electrical needs of an apartment complex or small shopping center with much higher efficiency than is possible with conventional systems.

OAO Corporation, Beltsville, Md., has been awarded a $2,271,391 contract by the Marshall Space Flight Center for the development of a data base management system which will accept sensor and mission related data at rates up to 50 million bits of data per second. The design, assembly, delivery, test and checkout of the system is to be completed within 22 months.



Safety at Shuttle Launch Pad—At complex 39A, the launch pad for the first Shuttle flights, one of the safety devices for the astronauts is the slide wire. There are five such wires running some 365 meters to the launch pad perimeter road. At the astronaut egress level of the gantry, slide wire cars are positioned so that in an emergency two persons can ride in each car to safety. At the end of the wire area is a bunker for protection and an M1-13 tank. Astronauts and white room personnel can drive away in the tank if the emergency warrants.



New Sun Catcher—A type of solar concentrator called line focusing, designed to track the Sun, is now being tested at the Marshall center. The unit, also known as a parabolic trough, is made up of four individual panels 6 meters long. Thermal fluid is carried in an absorber tube and MSFC's Solar Test Facility plans to heat the fluid to 150 degrees Celsius.

Did You Know?

Engineers at the Kennedy Space Center have begun a "grow your own" exploratory project designed to cut down on energy costs. Funded by NASA's Office of Energy Programs, the $20,000 study is aimed at finding an energy efficient method of using various plant species for use as energy sources. The study will examine plant utilization by direct combustion, digestion to methane and fermentation to alcohol. The latter is receiving the most attention at the present time, using sugar cane or cassava. The plants will be used to produce alcohol for use as gasohol or in a specially altered car which will run on pure alcohol.

NASA's Langley Visitor Center now provides a host of educational programs to school and youth groups that are specially tailored for different ages and interest levels. They are offered free of charge. For pre-school students, two programs have been developed: "Wings and Things" takes a very elementary look at things that fly and "Living in Space" teaches children about astronauts and life in space. Early and upper elementary programs deal with energy, flights, the solar system and space travel. Secondary through adult presentations include such topics as "NASA and Energy," "Flying Machines," "Exploration of the Solar System," "The Space Shuttle," "Manned Space Flight," "Spinoffs from Space Research" and "Voyager: Mission to the Outer Planets." The presentations make use of space artifacts and related exhibits at the Visitor Center. The energy programs use the adjacent energy research home as a teaching tool.

Arabella, one of Skylab's smallest passengers, has returned to the Marshall Space Flight Center from the Smithsonian Institution, Washington. Arabella, one of two "space spiders," participated in a web

formation experiment aboard the Skylab Space Station. Photographs of her webs were studied by Judith Miles of Lexington, Mass., the high school student investigator who proposed Skylab Student Experiment ED-52, Web Formation in Zero Gravity. The information obtained from these analyses provided insight into the motor-sensor and neuro-sensory performances of spiders in zero gravity. Initial investigation revealed the web to be finer than the one Arabella had made prior to her space voyage, thus lending insight into the use of body weight to determine the size of the webbing.

The KSC Awareness Report is a new daily on-center radio program, the first of its kind at a NASA Center. The innovative broadcast features news reports on everything from the latest payload lofted into orbit to the problems of preserving historic but deteriorating launch site structures. Produced by the Education and Awareness Branch of the Kennedy Space Center Public Affairs Office, the broadcast airs every weekday morning from 6 to 8 at 1610 KHz on the AM radio dial—the same frequency used later in the day to transmit visitor information to tourists driving onto KSC and Canaveral National Seashore.

Idea Clearinghouse this month cites Johnson Space Center's Margaret Coward, a cost-conscious Property Officers Representative, who has found a way to save on the ever-shrinking office supplies budget. Dispersant and toner for a Savin 770 copying machine were routinely purchased from the JSC stock catalog in a package called a "TD pack." However, since the machine uses six bottles of dispersant to one bottle of toner, the unused toner stacked up in storage areas. Ms. Coward noticed that a dispersant for a Savin 750 copier could be purchased separately. She ordered a trial box and found it was the same item contained in the TD pack. Separate purchases of dispersant and "TD packs" for all Savin copiers saves the Center approximately $666 per year.

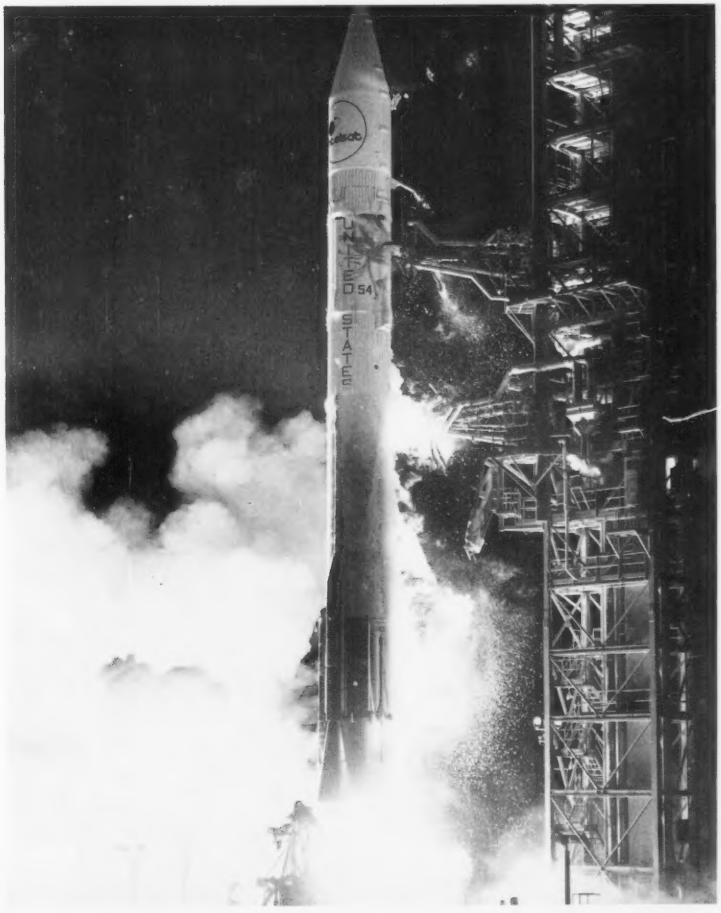
Patents for Inventions from NASA Research

The office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) & Employer	Title	Patent No.	Installation
Jack S. Margolis, Michael S. Shumate, Caltech/JPL, Pasadena.	Stark cell optoacoustic detection of constituent gases in sample	4,234,258	NRO/JPL
Robert W. Rosser, NASA/ARC	Perfluoroalkyl polytriazines containing pendent	4,234,715	ARC
Theodore Psarras, PCR, Inc., Gainesville, Fla.	iododifluoromethyl groups		
George F. Lutes, Jr., Caltech/JPL, Pasadena.	Precise RF timing signal distribution to remote stations	4,234,971	NRO/JPL
Terry L. St. Clair, NASA/LaRC	Method for preparing addition type polyimide prepregs	4,233,258	LaRC
Ralph C. Chernoff, Caltech/JPL, Pasadena.	Frequency translating phase conjugation circuit for active retrodirective antenna array	4,233,606	NRO/JPL
Bobby L. Berrier, NASA/LaRC	Thrust augmented spin recovery device	4,236,684	LaRC
M. Kudret Selcuk, NASA/NRO-JPL	Solar energy receiver for a stirling engine	4,236,383	NRO/JPL
John T. Mazur, NASA/LaRC	Telescoping columns	4,238,911	LaRC
Kenneth H. Lambson, NASA/ARC	Pressure control valve	4,239,057	ARC
Jack A. Kinzler, NASA/ARC	Structural members, method and apparatus	4,237,662	MSC
David S. Wang, Aubrey D. Warren, NASA/MSC	Installing fiber insulation	4,235,060	MSC
Allen R. McDougal, Caltech/JPL, Pasadena.	Phase-angle controller for stirling engines	4,240,256	NRO/JPL
Lawrence C. Montoya, Donald R. Bellman, NASA/DFRC.	Skin friction measuring device for aircraft	4,240,290	DFRC
Robert D. Reed, NASA/DFRC	Method for observing the features characterizing the surface of a land mass	4,240,601	DFRC
Alfred Cellier, Douglas C. Huey, and Lit N. Ma, NASA/JSC.	Digital numerically controlled oscillator	4,241,308	JSC
James R. Barnes, Marshall Yu Huang, NASA/JSC.	Self-calibrating threshold detector	4,241,312	JSC

Launches for 1981

Name	Launch Date	Vehicle	Range	Mission Remarks
COMSTAR-D ...	February 19	Atlas Centaur ..	ESMC	Comsat General Corp. Communications. Reimbursable.
INTELSAT V-B .	March 12	Atlas Centaur ..	ESMC	Intelsat communications. Reimbursable.
GOES-E	March	Delta	ESMC	NOAA weather. Reimbursable.
SBS-B	April	Delta	ESMC	SBS domestic communications. Reimbursable.
Navy-21	May	Scout	WSMC	DOD transit. Reimbursable.
NOAA-C	May	Atlas-F	WSMC	NOAA weather. Reimbursable.
FLTSATCOM-E .	June 2	Atlas Centaur ..	ESMC	DOD communications. Reimbursable.
RCA-D	June	Delta	ESMC	RCA communications. Reimbursable.
INTELSAT V-C .	June	Atlas Centaur ..	ESMC	Intelsat communications. Reimbursable.
Dynamic Explorer	July	Delta	ESMC	NASA scientific.
Navy-22	August	Scout	WSMC	DOD transit. Reimbursable.
Solar Mesospheric. Explorer	September	Delta	WSMC	NASA scientific.
INTELSAT V-D .	September	Atlas Centaur ..	ESMC	Intelsat communications. Reimbursable.



Last Launch for 1980—Intelsat-V, the largest advanced commercial satellite launched in 1980, successfully lifted off from Cape Canaveral Air Force Station at 6:31 p.m. December 6. The satellite will operate in a geostationary orbit 22,250 miles above the equates in the Atlantic Ocean to handle communications traffic across the Atlantic basin.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

A Beacon for Baltimore

Last spring, the square-rigged schooner *Pride of Baltimore* failed to make a scheduled stop at Norfolk, Va., on its goodwill tour of the United States. For several days, officials of the city of Baltimore, which owns the reconstructed 19th century clipper ship, tried without success to make contact with the *Pride*. Military ships and aircraft searched the Atlantic but failed to locate the ship. The *Pride* was feared lost.

Eight days later, the *Pride* sailed into Delaware Bay intact; severe storms had driven the vessel off course. Efforts to contact the *Pride* had failed because the schooner had been blown beyond the relatively short range of the ship's radio equipment.

The *Pride* will never become lost again thanks to a NASA-developed satellite beacon that now has been installed by the Goddard Space Flight Center. The simple 4.5 kilogram beacon, affixed to the mainmast, allows Baltimore Operation to keep track of the ship on its voyages to distant places. Once every minute the compact battery-powered unit sends a radio signal to NASA's Nimbus-6 research satellite. The satellite in turn relays the signals to Goddard where the frequency shift of successive signals provides information for computing the ship's latitude and longitude.

For the benefit of all . . .

NASA
National Aeronautics and Space Administration

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